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(54) BLOWOUT PREVENTER BYPASS.

(71) EXXON PRODUCTION RESEARCH COMPANY.

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(74) WM.

(57). CLAIM 1. An apparatus for drilling a subsea well from a drilling platform at the surface of a body of water, which comprises a riser conduit extending between the platform and the well; at least one blowout preventer connected to said riser conduit near the lower end thereof,

at least one fluid bypass conduit providing at least one fluid flowpath from the well at a point below said blowout preventer to the lower interior portion of the riser conduit at a point above the uppermost blowout preventer; and

a means in said bypass conduit for regulating fluid flow through said bypass conduit.

COMMONWEALTH OF AUSTRALIA

LOOSE

Patent Act, 1952-1969  
21 MAR 1977

## APPLICATION FOR A PATENT

498.216

(1) Here  
insert (in  
full) Name  
or Names of  
Applicant,  
Applicants,  
followed by  
Address (es).

~~XXX~~  
We

EXXON PRODUCTION RESEARCH COMPANY,  
of 3120 Buffalo Speedway,  
Houston, Texas,  
United States of America,

(2) Here  
insert Title  
of Invention.

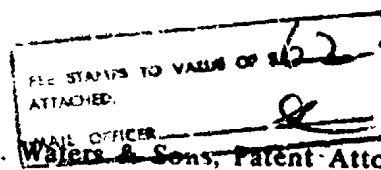
hereby apply for the grant of a Patent for an invention entitled: (2)

"SUBSEA HYDRAULIC CHOKE"

APPLICATION ACCEPTED AND AMENDMENT

ALLOWED 24 1 78

which is described in the accompanying ~~XXXXXXXXXX~~ specification.  
COMPLETE



~~XXX~~  
Our address for service is Messrs. Edwd. Wajers & Sons, Patent Attorneys,  
50 Queen Street, Melbourne, Victoria, Australia.

DATED this 18th day of March 1977

EXXON PRODUCTION RESEARCH COMPANY,

by E. B. Mischler Shi

(3) Signa-  
ture (s) of  
Applicant (s)  
or  
Sole or  
Company and  
Signatures of  
its Officers as  
prescribed by  
the Articles of



COMMONWEALTH OF AUSTRALIA

Patents Act 1952-1966

DECLARATION IN SUPPORT OF AN  
APPLICATION FOR A PATENT OR PATENT OF  
ADDITION

(1) Here  
insert (in  
full) Name of  
Company.

In support of the Application made by<sup>(1)</sup>

EXXON PRODUCTION RESEARCH COMPANY

(2) Here  
insert title  
of invention.

for a Patent for an invention entitled:<sup>(2)</sup>

"SUBSEA HYDRAULIC CHOKE"

(3) Here  
insert full  
Name  
and Address  
of Company  
Official  
authorised  
to make  
declaration.

I, <sup>(3)</sup> JAMES ARTHUR REILLY

of 3120 BUFFALO SPEEDWAY, HOUSTON, TEXAS,

UNITED STATES OF AMERICA

do solemnly and sincerely declare as follows:

1. I am authorized by<sup>(1)</sup> EXXON PRODUCTION RESEARCH COMPANY

the applicant for the patent to make this declaration on its behalf.

(4) Here  
insert (in  
full) Name  
and Address  
of Actual  
Inventor or  
Inventors.

2. <sup>(4)</sup> ROBERT ARTHUR NEATH of 2932 Chevy Chase, Houston, Texas,

United States of America

the actual inventor of the invention and the facts upon which<sup>(1)</sup>

EXXON PRODUCTION RESEARCH COMPANY

is entitled to make the application, are as follow:

The said<sup>(1)</sup> EXXON PRODUCTION RESEARCH COMPANY

is the assignee of the said<sup>(4)</sup> ROBERT ARTHUR NEATH

(5) Full Name  
of Actual  
Inventor or  
Inventors

Paragraph 2  
should be  
completed by

AUSTRIAN

21 MAR 1977

# COMPLETE SPECIFICATION

(ORIGINAL)

Application Number:  
Lodged:

Class

Int. Class

Complete Specification Lodged:  
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498,216

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Complete Specification for the invention entitled: "SUBSEA HYDRAULIC CHOKE"

The following statement is a full description of this invention, including the best method of performing it known to the inventor in the U.S.,

BACKGROUND OF THE INVENTIONField of the Invention:

The present invention pertains to restoring control of a well by regulating pressure in the wellbore while circulating out and killing a kick during drilling operations conducted from a floating vessel or drilling platform at the surface of a body of water.

Description of the Prior Art:

Drilling operations conducted from floating vessels normally involve the use of marine risers connecting the floating vessel with the wellhead and other equipment on the ocean floor. Such equipment usually includes a blowout preventer control system. The purpose of the blowout preventer system in floating drilling operations is to provide control when a kick occurs and to provide a means of circulating, conditioning, and returning the wellbore to a static condition. Usually, the blowout prevention system includes blowout preventers, a means of controlling release of fluid from the well, and a means of pumping fluid into the well.

Normally, hydrostatic pressure of the drilling fluid column in the well is greater than the pressure of the formation fluid, thus preventing the flow of formation fluids into the wellbore. When a formation with a pressure greater than the hydrostatic pressure in the well is encountered, formation fluids are able to enter the well. The initial influx of formation fluids is commonly referred to as a "kick". As long as hydrostatic pressures control the well, the blowout preventers are in the open position. Should a kick occur, however, blowout prevention equipment and accessories are actuated to close the well.

1           In most instances, when the blowout preventers are  
2 in the closed position due to an occurrence of a kick,  
3 additional action is required to restore control of the well.  
4 One problem associated with maintaining control can be attri-  
5 buted to the fact that formation fluids entering the well  
6 will nearly always contain some gas. This gas is potentially  
7 dangerous even if mixed with mud because it can expand greatly  
8 when it rises in the well. If the well is shut-in after the  
9 entry of appreciable gas and no attempt is made to remove the  
10 gas by circulation under controlled conditions, the gas will  
11 nevertheless rise in the shut-in well under the influence of  
12 gravity, without appreciable expansion. Under these condi-  
13 tions, when the gas reaches the point of shut-in, the pressure  
14 at that point may reach such proportions that pressure in the  
15 wellbore may result in surface equipment failure, casing  
16 failure, or formation breakdown. Such a situation may result  
17 in a blowout.

18           The primary objective in controlling wells which  
19 have been invaded by formation fluid is to circulate out any  
20 formation fluid influx while maintaining a constant bottom-  
21 hole pressure slightly greater than the pressure of the  
22 formation from the time the well kicks until the weight of  
23 the mud in the hole is sufficient to overbalance the forma-  
24 tion pressure. To accomplish this objective flow from the  
25 annulus is controlled with an adjustable choke so that the  
26 pressure of fluid pumped through the drill pipe to circulate  
27 out a kick can be controlled to maintain constant bottom hole  
28 pressure. By controlling release of fluids from the well the  
29 fluid pressure in the well can be regulated to allow for the

1 difference in weight between any heavy fluid being injected  
2 into the well and the light mud or gas return fluids and also  
3 allow for gas expansion. Controlled release of fluids from  
4 the well can also prevent excessive buildup of pressure that  
5 may fracture the formation or damage the casing. After the  
6 well fluids have passed through the choke, provisions are  
7 made for directing the fluids to waste pits, separators, mud  
8 tanks, or flares as desired.

9           In the past, in floating drilling operations  
10 controlled release of fluids from the well was accomplished  
11 through control lines extending from the blowout preventer or  
12 wellhead assembly to the drilling vessel on the surface of  
13 the water. Normally control lines would be attached to the  
14 outside of the riser assembly. On the floating vessel the  
15 high pressure fluids were passed through a choke to regulate  
16 the passage of fluid through control lines from below the  
17 closed preventer.

18           In deep water there are several disadvantages in  
19 having the wellbore fluid conducted to the vessel in this  
20 manner. One disadvantage is the danger that leaks may  
21 develop in the control line or in the high pressure choke  
22 manifold on the vessel. An uncontrolled release of high  
23 pressure fluids on the drilling vessel may endanger the  
24 drilling vessel as well as personnel on the vessel. Adverse  
25 conditions in the sea will increase the danger that the long,  
26 flexible control line may burst or leak. An additional  
27 disadvantage in having the high pressure control line extend  
28 to the drilling vessel is the problem of imposing an additional  
29 pressure on the casing and exposed formation due to dynamic

1 pressure loss in the long control line. A further disadvantage  
2 in having high pressure wellbore fluids conducted to the  
3 surface may occur with the control line becoming plugged due  
4 to the formation of hydrates in the well fluid at the sea  
5 floor or before the fluid reaches the surface choke manifold.

#### 6 SUMMARY OF THE INVENTION

7 This invention provides an improved apparatus and  
8 method for drilling a subsea well which allows control of  
9 wellbore pressure while circulating out and killing a kick  
10 and at least in part alleviates the difficulties outlined  
11 above. The present invention involves allowing fluid to be  
12 exhausted from the well at a point below some or all of the  
13 blowout preventers by means of at least one fluid conduit  
14 having a means in said conduit below the surface of the water  
15 to regulate fluid flow.

16 The improved method and apparatus are particularly  
17 useful in drilling operations of the type where a drilling  
18 platform fixed or floating on the surface of the water has a  
19 riser assembly extending between the drilling platform and  
20 the well and a blowout preventer is positioned therebetween  
21 near the lower end of the riser assembly. In accordance with  
22 the present invention at least one fluid bypass conduit  
23 provides a path for high pressure fluids to be exhausted from  
24 the well at a point below some or all of the blowout preventer  
25 components. A means in each of the said bypass conduits  
26 controls the flow of fluid through the conduit to regulate  
27 fluid pressure in the well after the blowout preventer compon-  
28 ents are in the closed position.



1           In the preferred embodiment of this invention two  
2 fluid bypass conduits each containing a hydraulic choke may  
3 be used to regulate fluid pressure in the well. Each bypass  
4 conduit is connected at one end to a blowout preventer  
5 assembly and the other end is connected near the lower end of  
6 the riser assembly. The blowout preventer assembly may  
7 comprise but is not restricted to a stack of four ram-type  
8 blowout preventers and two annular-type blowout preventers.  
9 The ram-type blowout preventers may comprise three pipe rams  
10 designated as the lower, middle, and upper pipe rams and a  
11 shear ram positioned above the upper pipe ram. One or more  
12 annular-type blowout preventers may be positioned above the  
13 shear ram. The lower end of one fluid bypass conduit is  
14 connected to the blowout preventer assembly at a point  
15 between the upper pipe ram and the middle pipe ram. The  
16 lower end of the other fluid bypass conduit is connected to  
17 the blowout preventer assembly at a point between the lower  
18 pipe ram and middle pipe ram. Each of the bypass conduits  
19 contains a hydraulic choke of conventional design for regu-  
20 lating fluid flow through said conduits. A pressure transducer  
21 is attached upstream of the hydraulic choke to each of the  
22 conduits to monitor the fluid pressure in the well. In  
23 addition, each bypass conduit contains two or more valves to  
24 control fluid flow through the conduits.

25           In the practice of the preferred embodiment when a  
26 well is closed by the blowout preventers, fluid pressure in  
27 the well can be regulated by controlled release of fluids  
28 from the well. In most instances a well is closed by closing  
29 the annular blowout preventers, the upper pipe rams or the

1 middle pipe rams and preventing passage of fluid into the  
2 upper control line and bypass conduits. This may be accom-  
3 plished in the bypass conduits by closing the valves or the  
4 chokes, if designed for full closure, and the upper control  
5 line by closing valves. When it is desirable to circulate  
6 out and kill a kick with the drill pipe at or near bottom, a  
7 fluid may be pumped into the drill pipe. Controlled release  
8 of fluid from the annulus between the drill pipe and casing  
9 below the closed blowout preventer is accomplished by allow-  
10 ing fluid to pass through a fluid bypass conduit which  
11 contains a hydraulically activated choke. The choke in each  
12 bypass conduit can be adjusted to permit the proper flow  
13 rate to maintain a desirable bottomhole pressure. By closing  
14 the choke the fluid pressure in the well can be increased  
15 and by opening the choke the pressure can be decreased.  
16 After passing through the choke, the fluids may be injected  
17 into the riser at a point near the lower end of the riser  
18 wherein the fluids are transported to a diverter at the top  
19 of the riser whose annulus with the drill pipe is sealed by  
20 a packer.

21 In other embodiments of this invention, fluids  
22 discharged from the choke may be vented to the sea by opening  
23 a valve which communicates with the sea or injected into a  
24 low pressure control line which terminates on the drilling  
25 vessel.

26 Each bypass conduit may include a means for moni-  
27 toring the fluid pressure in the well. After the well is  
28 first shut-in, it is often desirable to know the fluid  
29 pressure in the well. A pressure transducer attached to

1 each bypass conduit can transmit a signal to the drilling  
2 vessel where the pressure can be monitored.

3 By practicing this invention the problems associa-  
4 ted with having the high pressure fluids choked on the  
5 water's surface are obviated. Since the high pressure  
6 fluids from the well are choked below the surface of the  
7 water there is no danger of a release of high pressure  
8 fluids on the drilling vessel. In addition, the disadvan-  
9 tages of having a long, flexible control line extending to  
10 the drilling vessel are at least in part alleviated since  
11 the fluid bypass conduit is connected to the riser below the  
12 surface of the water. Thus, there is a decreased danger  
13 that the bypass conduit may break or burst due to adverse  
14 conditions in the sea and also there is substantially less  
15 pressure drop in the bypass conduit. In addition, this  
16 invention eliminates plugging of control lines by hydrates.  
17 The method and apparatus of the present invention therefore  
18 will be seen to offer significant advantages over the systems  
19 existing heretofore.

#### 20 BRIEF DESCRIPTION OF THE DRAWING

21 FIGURE 1 in the drawing depicts a floating drilling  
22 vessel positioned at the surface of a body of water with  
23 fluid bypass conduits connecting the lower portion of the  
24 blowout preventer with the riser; and

25 FIGURE 2 is an enlarged schematic drawing of fluid  
26 bypass conduits connecting the lower portion of a blowout  
27 preventer to a riser.

DESCRIPTION OF THE PREFERRED EMBODIMENT

1 The drawings depict an apparatus suitable for the  
2 practice of this invention. Shown in FIGURE 1 is a drilling  
3 vessel 11 positioned at the surface 12 of a body of water  
4 overlying an underwater wellhead and related equipment. The  
5 drilling vessel is held in position over the location by  
6 means of mooring lines 13 and 14 which extend downwardly to  
7 anchors (not shown) imbedded in the ocean floor 15. The  
8 vessel is equipped with a derrick 16, a hoist system 17, a  
9 rotary table 18, and other conventional equipment employed  
10 for drilling purposes. The derrick is positioned over a  
11 well or slot 19 through which equipment can be raised and  
12 lowered.

13 The underwater wellhead assembly depicted in  
14 FIGURE 1 includes a temporary base member 20 which is posi-  
15 tioned on the ocean floor and is secured by a ball-and-  
16 socket joint to a conductor pipe 22 extending into the well.  
17 The conductor pipe is cemented in place as indicated by  
18 reference numeral 23. A casing head nest 24 is attached to  
19 the conductor pipe extending through the temporary base  
20 member 20. A drilling wellhead assembly above the casing  
21 head nest includes a detachable wellhead connector 26 of  
22 conventional design. As shown more clearly in FIGURE 2,  
23 connected above the upper end of this are ram-type blowout  
24 preventers 27, 28, 29, and 30, and two annular-type blowout  
25 preventers 31 and 32. Blowout preventers 28, 29, and 30 are  
26 pipe rams and blowout preventer 27 is a shear ram. A ball  
27 joint 33 is connected into the assembly above the blowout  
28

1 preventers and a remotely operated quick disconnect and  
2 sealing assembly (not shown in the drawings) may also be  
3 employed. A sectionalized marine conductor pipe or riser 34  
4 and upper control line 35 extend upwardly to the drilling  
5 vessel at the water's surface.

6           Fluid bypass conduits 36 and 45 are connected at  
7 one end to riser 34 near the annular blowout preventer 32  
8 and at the other end to the blowout preventer system.  
9 Bypass conduit 36 is connected to the blowout preventer  
10 system at a point between lower pipe ram 30 and middle pipe  
11 ram 29. Bypass conduit 45 is connected to the blowout  
12 preventer system at a point between the upper pipe ram 28  
13 and middle pipe ram 29. Hydraulic chokes 37 and 43 are  
14 situated in bypass conduits 36 and 45, respectively. Also  
15 situated in each of the bypass conduits are valves 46, 47,  
16 48, 49, 53, and 54. Pressure transducers 42 and 44 are  
17 situated on the bypass conduits 36 and 45 between the hydraulic  
18 chokes and blowout preventers.

19           In the practice of this invention when a kick  
20 occurs, formation fluids around the wellbore begin flowing  
21 and the blowout preventer system closes the well. Referring  
22 again to FIGURE 2, the blowout preventer system closes the  
23 well by the closing of annular blowout preventers 31 and 32,  
24 shear ram 31, or upper pipe ram 28, or any combination of  
25 these preventers. Preferably valves 46, 47, 48, 49, 50, 51,  
26 52, 53, and 54 are also in the closed position in order  
27 to prevent passage of fluid through the bypass conduits or  
28 the upper control line. Preferably the chokes in the bypass  
29 conduits are also closed. To return the well to a stabilized

1 condition, mud is injected into the well through a drill  
2 pipe to the bottom of the well and returned through the  
3 drill pipe-casing annulus. The weight of this mud is increas-  
4 ed to exert a hydrostatic pressure slightly greater than the  
5 calculated formation pressure in order to stop the influx of  
6 formation fluids. The mud density necessary to kill the  
7 well can be determined by one of ordinary skill in the art.  
8 Selection of the mud injection<sup>4</sup> rate should be made after  
9 thorough consideration of the well conditions such as shut  
10 in pressure, pump capacity, and frictional losses resulting  
11 from circulation. This too can be determined by one skilled  
12 in the art. Once stabilized circulation is established the  
13 injection rate of the mud should be constant until the well  
14 is closed again or until it is killed.

15           High pressure fluids in the well are allowed to  
16 escape through either fluid bypass conduits 36 or 45. It is  
17 preferred that only one fluid bypass conduit be used in  
18 order to save the other conduit for use in the event the  
19 first conduit leaks, bursts, wears out or is otherwise in an  
20 inoperable condition. For safety reasons, it is further  
21 preferred to use the bypass conduit 45 before using bypass  
22 conduit 36. For example, if a leak developed in the system  
23 at any point above the middle pipe ram 29, the middle ram  
24 could be closed to stop the leak and bypass conduit 36 could  
25 alternatively be used for controlled release of fluids from  
26 the well.

27           Hydraulic chokes 37 and 43 regulate the flow of  
28 fluid through bypass conduits 36 and 45 respectively. The  
29 choke setting at the outset of the killing operation or

1 after a prolonged shut-in period should be such that the  
2 annulus pressure during circulation is slightly higher than  
3 the shut-in pressure immediately preceding circulation.  
4 When circulating a kick out of the well in this manner, the  
5 bottom hole pressure is the pressure of the mud column plus  
6 whatever overpressure is added to the normal circulating  
7 pressure. Therefore, the amount of the overpressure is  
8 controlled by the choke pressure. For example, if it is  
9 desired to decrease the bottom hole pressure the hydraulic  
10 choke can be opened wider and if it is desired to increase  
11 the bottom hole pressure the hydraulic choke can be closed  
12 more to restrict flow. If the weight of the mud being  
13 circulated does not vary the bottom hole pressure will  
14 remain constant. However, if the density of the mud increases  
15 in a manner as previously stated and the mud is injected at  
16 a constant rate the pumping pressure should be reduced to  
17 compensate for the increased hydrostatic mud head in order  
18 to maintain a constant bottom hole pressure. By adjusting  
19 the hydraulic choke in the bypass conduit to control the  
20 rate of fluid flow from the well the pressure required to  
21 inject the mud can be varied and thus the bottom hole pressure  
22 can be maintained at the level desired to prevent formation  
23 fluids from flowing into the well.

24 Bypass conduits 36 and 45 continue past the hydrau-  
25 lic chokes to the riser assembly at a point near the annular  
26 blowout preventer 32. In the practice of this embodiment  
27 valves 53 and 54 are open and valves 51 and 52 are closed.  
28 The bypass conduits may be connected to the riser at any  
29 point. However, it is preferred to have the connection as  
30 close as practicable to the uppermost blowout preventer

1 component. This is preferable in order to reduce the flowpath  
2 of the high pressure fluids through the bypass conduit. By  
3 having a short bypass conduit the dynamic pressure losses  
4 are decreased and the chance of a leak or break developing  
5 in the conduit are reduced. After injection into the riser  
6 the fluids are allowed to pass up the riser to a gas diverter  
7 positioned at the top of the riser. Although a gas diverter  
8 is not always required, it is preferable to use such equipment  
9 to divert gas away from the rig. To assist in lifting the  
10 muds, formation fluids, and cuttings up the riser and to  
11 dilute the gas flowing up the riser, additional fluids may  
12 be passed through flowline 50 and injected into the riser at  
13 a point near the lower end of the riser.

14         An alternate route from downstream of the choke or  
15 chokes may be to discharge the vented well fluid into low  
16 pressure conduits 60 and 61, positioned adjacent to, or  
17 attached to the riser by opening valve 51 and closing valve  
18 53 or opening valve 52 and closing valve 54, respectively.  
19 In most instances conduits 60 and 61 will be used to transport  
20 fluids to the drilling vessel when the riser is damaged.

21         Another route for fluids from downstream of the  
22 choke or chokes may include the discharge of such fluids  
23 into the water provided the fluids do not pollute or contamin-  
24 ate the environment. Valving and lines illustrating this  
25 embodiment are omitted from FIGURES 1 and 2 for simplicity.

26         In the event the floating vessel leaves the location  
27 in an emergency, which requires cutting the drill pipe and  
28 releasing the riser, the drill pipe is suspended in the  
29 upper pipe ram 28 and cut in two by activating the shear  
30 ram 27 which also seals the wellbore. When the drill vessel



1 returns to the location and the riser is reinstalled, the  
2 valves 40 and 41 on the upper control line 35 are opened and  
3 fluid is pumped into the upper control line through the cut  
4 and suspended drill pipe to the bottom of the well and  
5 returns up the annulus and through one of the bypass lines.  
6 The returns are controlled by the choke in the bypass line  
7 to maintain the pressure required to control the formation  
8 pressure. As previously discussed, fluid from the choke may  
9 be discharged into the riser, ocean or a separate low pressure  
10 line attached to the riser and terminated at a fluid separator  
11 on the drill ship.

12 It should be understood in the practice of this  
13 invention one or more bypass conduits containing a choke can  
14 be used to control the release of high pressure fluids from  
15 the well. At least one bypass conduit is required in the  
16 practice of this invention, but as can be appreciated from  
17 prior discussion of this invention, more than one bypass  
18 conduit is desirable in order to add redundancy to the  
19 system.

20 The hydraulic chokes used in the practice of this  
21 invention can be any commercially available choke which can  
22 be used to regulate the flow of fluid in the manner as  
23 disclosed herein. An example of two commercially available  
24 chokes which may be used to practice this invention include:  
25 "The Cameron Power Operated Choke" manufactured by Cameron  
26 Iron Works Inc. of Houston, Texas, U.S.A. and "Super Choke --  
27 10,000 psi" manufactured by Swaco Operations/Dresser Indus-  
28 tries, Inc. of Houston, Texas. These are adjustable chokes  
29 which allow remote changes in choke size which are necessary

1 for the kill procedures previously presented. The hydraulic  
2 chokes may be controlled by the blowout preventer control  
3 system. More specifically, hydraulic fluids used to operate  
4 the blowout preventer system may be used to adjust or regulate  
5 the hydraulic choke.

6 For circulation flexibility and in event the  
7 bypass choke line should leak or break, valves are placed in  
8 conduit 36 and 45. In most instances dual, hydraulically  
9 operated, fail-safe valves are recommended for the outlet of  
10 the bypass conduits. Since side outlets are known areas for  
11 sand cutting and erosion these valves should be positioned as  
12 close to the blowout preventer stack as possible and with a  
13 minimum of connections between the stack and the valves. At  
14 least one of the valves should be connected directly to the  
15 stack and preferably before the flow line or conduit path  
16 makes a turn. It would be better if both could be located  
17 before this turn in the flow path. However, there is a width  
18 restriction on the stack and the valves are vulnerable to  
19 being broken off if they extend too far. For these reasons,  
20 one valve may be located directly on the stack and the second  
21 after the turn in the flow path.

22 A pressure monitoring means may be connected to the  
23 well apparatus to detect fluid pressure in the well. It is  
24 preferred that the pressure monitoring means be a pressure  
25 transducer connected to each of the bypass conduits between  
26 the choke and the well. The pressure transducer may send a  
27 signal to the surface indicative of fluid pressure in the  
28 well. The signal can be received at the surface and the  
29 fluid pressure in the well determined. From such information

1 a well operator can adjust the choke in the appropriate  
2 bypass conduit to regulate passage of fluid through the  
3 conduit in order to control pressure in the formation. For  
4 example, if the fluid pressure in the well is increasing the  
5 operator can adjust the hydraulic choke to permit more fluid  
6 to pass through the conduit in order to reduce the pressure  
7 in the well in a manner as previously described. On the  
8 other hand, if the pressure in the well is decreasing, the  
9 operator can adjust the choke means to restrict passage of  
10 flow through the conduit.

11 This method of monitoring the high pressure fluid  
12 in the well for the adjustment of the hydraulic choke is  
13 particularly useful during the period after the well is shut-  
14 in and before the fluids are circulated in the well. When  
15 muds are pumped into the well at a constant rate and the  
16 density of the mud is increasing, in order to maintain a  
17 constant bottom hole pressure the pressure required to  
18 inject the muds must be allowed to change. By controlling  
19 release of fluids through the bypass conduits in a manner as  
20 previously described, the pressure required to inject the  
21 muds into the well can be varied as desired. Therefore, the  
22 operator would be more likely to use a pressure monitoring  
23 means to measure the pressure of the muds being injected into  
24 the well rather than the fluid pressure in the bypass conduits  
25 under those circumstances where a well is being brought under  
26 control by the injection of higher density muds.

27 An automatic choke adjusting means can be used in  
28 this invention to regulate the fluid pressure through the  
29 bypass conduit. For example, a monitoring means can be  
30 connected to the well apparatus to detect fluid pressures in

1 the well. The monitoring means would send a signal to a  
2 choke adjusting means which would regulate the choke auto-  
3 matically in response to signals from the monitoring means.  
4 If the pressure in the well started to increase the pressure  
5 monitoring means would send a signal to the choke adjusting  
6 means indicative of this and the choke adjusting means would  
7 in turn adjust the choke means to permit more fluid to pass  
8 through the conduit and thus reduce the pressure in the well.  
9 Generally, the subsea choke can be adjusted to maintain a  
10 constant drill pipe pressure in exactly the same manner as  
11 when the choke is located at the surface.

12           It will be understood that the drilling apparatus  
13 of this invention is not restricted to the precise configura-  
14 tion illustrated in the drawings and that various changes in  
15 the shape or type of fluid bypass conduit, choke valve, or  
16 other elements may be made.

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~~What is claimed is:~~ THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:-

1 1. An apparatus for drilling a subsea well from a  
2 drilling platform at the surface of a body of water, which  
3 comprises

4 a riser conduit extending between the platform and the  
5 well;

6 at least one blowout preventer connected to said riser  
7 conduit near the lower end thereof,

8 at least one fluid bypass conduit providing at least  
9 one fluid flowpath from the well at a point below  
10 said blowout preventer to the lower interior  
11 portion of the riser conduit at a point above the  
12 uppermost blowout preventer; and

13 a means in said bypass conduit for regulating fluid  
14 flow through said bypass conduit.

1 2. The apparatus of claim 1 wherein two fluid  
2 bypass conduits provide fluid flowpaths from the well at a  
3 point below said blowout preventer.

1 3. The apparatus of claim 1 wherein the means for  
2 regulating fluid flow is a hydraulic choke.

1 4. The apparatus of claim 3 wherein the hydraulic  
2 choke is remotely operable.

1 5. The apparatus of claim 1 including valve means  
2 in each said fluid bypass conduit.

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1           6. The apparatus of claim 1 wherein said bypass  
2 conduit contains at least one pressure monitoring means  
3 situated on each bypass conduit between the means for regu-  
4 lating fluid flow and the well.

1           7. The apparatus of claim 6 wherein said pressure  
2 monitoring means includes a pressure transducer.

1           8. An apparatus for drilling a subsea well from a  
2 drilling platform at the surface of a body of water, which  
3 comprises  
4       a riser conduit extending between the platform and the  
5       well,  
6       a blowout preventer assembly comprising at least one  
7       blowout preventer connected to the lower end of  
8       said riser conduit,  
9       at least one fluid bypass conduit providing at least  
10      one fluid flowpath between the well at a point  
11      below at least one of said blowout preventers to  
12      the lower interior portion of the riser conduit at  
13      a point above the uppermost blowout preventer; and  
14      a means in each said bypass conduit for regulating  
15      fluid flow through said bypass conduit.

1           9. In a method for regulating pressure in a  
2 subsea well while circulating out and killing a kick during  
3 drilling operations conducted from a drilling platform by  
4 equipment which includes a riser conduit extending between  
5 the drilling platform at the surface of the water and the  
6 well and at least one blowout preventer being positioned  
7 therebetween near the lower end of the riser conduit, the  
8 improvement comprising  
9           conducting well fluids from a point below said blowout  
10           preventer to the lower interior portion of the  
11           riser conduit at a point above the uppermost  
12           blowout preventer by means of at least one fluid  
13           bypass conduit; and  
14           regulating the passage of fluid through said bypass  
15           conduit at a point in said bypass conduit.

1           10. The method of claim 9 wherein fluid flow  
2 through the bypass conduit is regulated in said conduit near  
3 the lower end thereof.

1           11. The method of claim 9 further comprising  
2 monitoring the pressure of fluids in the bypass conduit  
3 between the means for regulating fluid flow and  
4 the well by means of a pressure sensing device,  
5 adjusting the means for regulating fluid flow in response  
6 to a pressure change in the bypass conduit for  
7 controlling fluid pressure in the well.

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- 1           12. The method of claim 11 whersin the pressure of  
2 fluids is monitored by at least one pressure transducer.

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